Transport Simulations with π and Δ In-Medium Properties*

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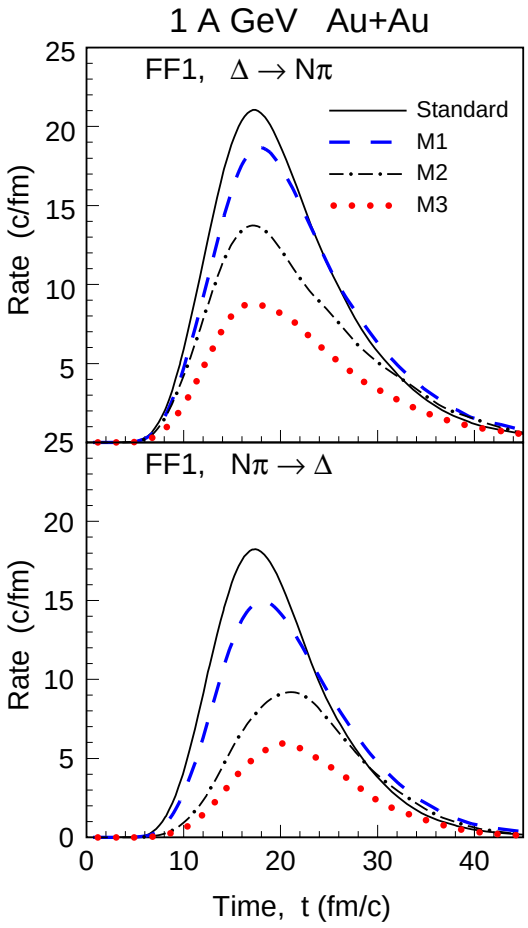
In collisions between two heavy nuclei at bombarding energies from a few hundred MeV up to several GeV per nucleon, hadronic matter at high density and temperature is formed and the production of the large number of energetic particles can be fairly well described by microscopic transport models employing vacuum properties of resonances and mesons. However, π mesons, nucleons, and Δ isobars are strongly interacting particles that couple to form spin-isospin modes. in the nuclear medium.

We have presented selected results from transport simulations incorporating in-medium properties of pions and Δ isobars. In particular, we have included in-medium pion dispersion relations, partial Δ widths, pion reabsorption cross sections, $NN \leftrightarrow \Delta N$ cross sections and Δ spectral functions. These in-medium quantities have been calculated microscopically from the ΔN^{-1} model presented in Ref.[1] and incorporated into the transport formalism of Li and Bauer [2] by a local-density approximation.

The simulations that include the medium modifications show strong effects on properties not directly observable during the collision process, such as pion and Δ production and reabsorption rates, but only minor effects on spectra of emitted pions. This is rather reasonable since most of the emitted pions are produced at the surface at low densities where the in-medium effects are quite small. However, in an energetic nucleus-nucleus collision also other particles, not studied in this work, are produced in multistep processes, where Δ's and pions act as intermediate particles. Thus, modified properties of Δ's and pions in the nuclear medium might be important to consider when studying production of such secondary particles.



The time dependence of the rates for Δ decay (upper panel) and the time dependence of the rates for the reserve process, the reabsorption of a pion on a nucleon (lower panel), using theparameter set FF1.

We expect that the present transport simulations contain the most important in-medium features. Furthermore, they provide the most consistent tests carried out so far of in-medium effects within ΔN^{-1} models.

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[1] J. Helgesson, J. Randrup, Ann. Phys. 244 (1996) 12; J. Helgesson, J. Randrup, Nucl. Phys. A597 (1996) 672.

[2] B.A. Li and W. Bauer, Phys. Rev. C44 (1991) 450.